moving toward the right-hand side, the rack **44** moves to the back by one tooth. Therefore, the movable unit **5** moves one row at the back of the tactile pins **10**. Consequently, the n-th actuation pin **16** comes to the right-hand side to the tactile pin **10** which is in the 64-th column and the {(n−1)×6+2}-th row. After the actuation projection **59** has passed over the left-hand side dog **60**, the actuation pins **16** reach the tactile pins **10** belonging to the 64-th column and move further to the right toward the tactile pins **10** belonging to the first column, during which the third photosensor **39** detects the timing of turning on of the solenoids as in the case of the movement to the left-hand side described above and an ON-command is fed to selected ones of the solenoids **4**. As the actuation pins **16** pass beyond the tactile pins **10** belonging to the first column, the actuation projection **59** passes over the right-hand side dog **61**. In this case, because the actuation projection **59** is moving toward the right-hand side, the rack **44** moves to the back by one tooth. Therefore, the movable unit **5** moves one row at the back of the tactile pins **10**. As a result, the n-th actuation pin **16** comes to the right-hand side to the tactile pin **10** which is in the first column and the {(n−1)×6+3}-th row. After the actuation projection **59** has passed over the right-hand side dog **61**, the second photosensor **38** detects the right-hand side reverse position and the motor **25**, after stopping once, drives to again move the movable unit **5** toward the left-hand side.

[**0075**] In a similar fashion, the movement toward the left-hand side and the movement toward the right-hand side of the movable unit **5** is repeated for three reciprocal movements. During the third movement toward the right-hand side, the motor **25** does not stop even when the second photosensor **38** detects the right-hand side reverse position and the movable unit **5** further moves toward the right-hand side. As the movable unit **5** further moves toward the right-hand side beyond the right-hand side reverse position, the ratchet arms **48**, **51** abut with the abut member for reset **62**, the backstop parts **48***a* **51***a* and the ratchet gear teeth **44***a* of the rack **44** are reset, i.e., are disengaged from each other. Hence, the rack **44** moves toward the front and returns to the state as it was before the motor started. In synchronization with this, the first photosensor **37** detects the stop position, the motor **25** stops and the horizontal and vertical movement of the movable unit **5** end.

[**0076**] The control part **8** of the tactile display apparatus **1** controls turning on and off of the solenoids **4** based on a data signal from the host computer PC, differences in elevation are created among the tactile pins **10**, and an image is displayed. Briefly with respect to control for the host computer PC, first, the host computer PC receives image date, such as a camera image or a scanner image, processes the received image data in an image processing module, and creates an image file (e.g., jpeg, bitmap).

[**0077**] This is followed by pixelating the data of the image file in accordance with the arrangement of the tactile pins **10** of the tactile display apparatus **1** described above, to thereby turn the data into a 64×48 grid.

[**0078**] To divide pixels thus treated by pixelation into convexes (corresponding to ON solenoids) and concaves (corresponding to OFF solenoids) on the display board portion **3**, binarization is executed with reference to a threshold value which has been determined in advance.

[**0079**] The binarized data are sorted in accordance with an order in which the solenoids **4** of the tactile display apparatus **1** act upon the tactile pins **10**, and the 64×48=3072 pixels are divided into a few blocks and output in a predetermined serial communication format (e.g., as ASC data) in the block order, at a COM port, to the tactile display apparatus **1**. A control code is transmitted concurrently, for the purpose of control to start up the display apparatus **1**.

[**0080**] By means of the exemplary structure described above, the tactile display apparatus **1** shows image information, such as a photograph, a graphic and/or a letter, as differences in elevation created among the tactile pins **10** which are disposed in a matrix arrangement. When a visually handicapped person touches the display by hand, he can recognize the image information. The solenoids **4** for controlling projecting or retracting of the tactile pins **10** are disposed at the movable unit **5** which is capable of moving horizontally and vertically.

[**0081**] This greatly reduces the number of the solenoids **4** relative to the many tactile pins **10** which are disposed in a matrix arrangement, achieves a reduction in the number of the components, shortens the assembling step and contributes to cost reduction.

[**0082**] Further, a solenoid **4** is disposed in a row vertically with five tactile pins **10** spacing between adjacent solenoids **4**, the tactile pins **10** also disposed in the vertical direction. As the movable unit **5** moves in the horizontal direction and the vertical direction repeatedly, the tactile pins **10** are moved upward by the solenoids **4**. Because this contributes to a reduction in the number of the solenoids **4** and allows setting the adjacent gaps between the tactile pins **10** narrowly without being restricted by the dimensions of the solenoids **4**, it is possible to finely display information, such as an image, and obtain a sharp tactile screen at a high resolution. While the intervals between the solenoids **4** are five tactile pins **10** between adjacent solenoids **4** in this exemplary embodiment, the invention is not so limited and any desired number of tactile pins can be disposed between adjacent solenoids. Alternatively, the solenoids may be disposed in a row not only vertically but also horizontally or even in a plurality of rows.

[**0083**] In addition, while control of the projecting of the tactile pins **10** by the solenoids **4** is achieved via the actuation pins **16**, because the actuation pins **16** rise up and push up the tactile pins **10** to the upper movable positions as the solenoids turn on but move down and leave the tactile pins **10** untouched when the solenoids turn off and because the upward movements of the actuation pins **16** takes place while the movable unit **5** moves, projecting and the subsequent retracting, using roller **17**, of the tactile pins **10** is controlled continuously and efficiently.

[**0084**] Even further, because the movable unit **5** will not contact or become connected with the display board portion **3** except for pushing of the tactile pins **10** by the actuation pins **16**, the movable unit **5** moves vertically and horizontally at a high speed and data inputted from the host computer PC is displayed quickly on the display board portion **3**.

[**0085**] Because the movable unit **5** moves horizontally beyond the range in which the solenoids **4** move the tactile pins **10** upward and the movable unit **5** moves vertically while moving in the horizontal direction beyond this range, the movable unit **5** can move in the vertical direction and the